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SEQUENCE IN THE DISTRIBUTION OF AQUATIC SPECIES

BY CALVIN GOODRICH

That section of Tennessee made up of the counties of Clay, Jackson, Overton, Pickett and Fentress has the Cumberland River for its main stream. The largest tributary is Obey River, dividing upstream into West and East Forks. Resembling it faunistically to a certain degree is Wolf River. Fringing the Cumberland, Obey, the Obey Forks and the Wolf are numbers of streams locally called creeks or branches, but most of them too small for recognition by name on the ordinary maps. Matching those streams of East Tennessee known as Sinking creeks is Cowan's Branch, which like them is both of the surface and underground. The section is the country known to malacologists by the collecting enterprises of Paul Adams, whose home is (or was) Alpine, and W. S. Parris, living in a community that began as Boom, became Wirmingham and now, by recent choice, is Boom again. It is the land, too, of Alvin York who in the World War and all alone took prisoners in what you might speak of as herds.

Mr. C. S. Shoup of Vanderbilt University has made a fisheries survey of the section. As a part of the task, he gathered mollusks at more than fifty different stations. The Pleuroceridae were sent to me, and what follows is the result of a study of the specimens.

The Cumberland River contains the largest number of species and probably the largest colonies. A single genus of the four genera inhabiting the region is absent from the river, and that one is present in the Cumberland above the head of navigation. From the river in something like orderly sequence as we pass from big stream to smaller stream and then to smallest, the species

radiate in lessening numbers. The Cumberland pleurocerids taken by Mr. Shoup consist of:

Pleurocera canaliculatum subspecies or form *undulatum* (Say)
subspecies or form *filum* (Lea)
alveare (Conrad)
Lithasia armigera (Say)
geniculata Haldeman
Anculosa praerosa Say

P. canaliculatum filum is the characteristic upstream form, being marked particularly by deep sulcations of the whorls above the periphery. It is succeeded downstream by the smoother *undulatum*. Even in so short a stretch of river as that under consideration there is a change in relative populations. *Filum* amounts to 36.5 per cent of the specimens of *canaliculatum* collected at the uppermost station, but to only 8.8 per cent at the lowermost. *P. alveare, L. armigera* and *geniculata* have the strong sculpture accepted as typical. *A. praerosa* differs little from the Ohio River form, the first to meet with naturalists' attention. Paul Adams took *P. walkeri* Goodrich in the Cumberland at Granville, Jackson County, below Mr. Shoup's downriver station. This is a slender form of the subgenus *Strephobasis* and is to be considered either a relict species or a race peculiarly restricted in its ecological tolerance. Another missing species is *P. curtum* (Haldeman). It is known both from above and below the area, but earlier records as well as the present one indicate the existence here of a gap in its distribution. The heavy, short-spired *ponderosum* (Say) is the only *Campeloma* taken with the exception of one specimen of *decisum* found near or at a creek mouth and which, in all likelihood, originated in the smaller stream.

The Pleuroceridae of Obey River below the "Forks" are:

Pleurocera canaliculatum undulatum (Say)
alveare (Conrad)
Lithasia armigera (Say)
armigera stygia (Say)
geniculata venusta (Lea)
obovata (Say)
obovata form *depygis* (Say)
Anculosa praerosa Say
Goniobasis sp.

P. c. undulatum inhabits the whole length of Obey River proper. It is less robust than in the Cumberland and sulcae are absent, but the relative proportions of altitude to diameter are virtually the same. The sculpture of *P. alveare* is typical although less pronounced and this may be simply because the shells are comparatively small. Going upstream, *L. armigera* retains its sculpture until the uppermost station is reached. The shells of this locality, subspecies *stygia*, are without nodes on the periphery, but still plicate on the spire. Contrasting with this is *L. geniculata*. The typical, short-spired, nodulous shell of the Cumberland does not appear to enter the Obey River at all. It is replaced by the smooth, high-spired form which Lea gave specific rank as *venusta*. The subspecies occurs in the four lower stations, but seemingly is absent from the three higher ones. *L. obovata*, as form *depygis*, is in the middle reaches of the river. With the shells were taken two specimens much nearer the typical conformation. The *Goniobasis* sp. is a single juvenile individual too small to be determined. The genus, where it occurs in the Obey, is probably a straggler from creeks or brooks. *Campeloma*, collected in only one locality, is *decisum* or near it.

So far as collecting records show, the East Fork of Obey River is barren of Pleuroceridae. Mr. Shoup has indicated a reason for this by marking the results of hydrogen ion concentration tests upon a copy of his field chart. The average of five such analyses in the East Fork is 6.1. The pH in the highest station is 5. It is as low as 2.6 in one tributary. Comparison may be made with a pH of 7.8 near the mouth of the West Fork. Pleuroceridae of this stream are:

Pleurocera canaliculatum undulatum (Say)
alveare (Conrad)
Lithasia obovata (Say)
obovata sordida (Lea)
Anculosa praerosa Say
subglobosa Say
Goniobasis ebenum (Lea)
edgariana (Lea)

P. c. undulatum and *A. praerosa* are in the list on the basis of Mr. Parris' findings. *A. subglobosa*, taken by Mr. Shoup near the

mouth of Nettlecarrier Creek, is represented by two specimens and may be counted as a small stream inhabitant. The large *Lithasiae* have dropped out. *L. obovata sordida* is of irregular occurrence in this drainage basin and it is possible that the exact environmental conditions suitable for it are of irregular occurrence also. *Goniobasis* is becoming the dominant genus. *P. alveare* in the West Fork is of the form described by Anthony as *Melania grossa*. In this shell, the plicae of the spire remain, but the nodules of the lower whorls have disappeared. In most regards, the pleurocerids of Wolf River resemble those of the West Fork of the Obey, but *L. armigera stygia* occurs in the stream near its mouth and *G. edgariana* has not been taken in it anywhere.

Lithasia armigera is present in Roaring River, which appears to be the third largest tributary of the Cumberland in the area, but is confined to its mouth. About midway in this stream, *Anculosa praerosa* was taken. At one time, it probably occupied lower stations also. Three shells, identifiable as *Goniobasis laqueata,* were found in Roaring River. This is a rare species in this particular region, but it occurs in Cumberland River forks, creeks and springs both up the river and down it. Collections made in tributaries of the streams dealt with are made up of:

Lithasia obovata (Say)
obovata sordida (Lea)
Goniobasis ebenum (Lea)
edgariana (Lea)
laqueata (Say)

The commonest species is *G. edgariana*. It is an occupant of springs as well as of creeks. *G. laqueata* is from only one of twenty-five streams. *G. ebenum* although at three stations of Wolf River was found in only one of eight of its tributaries. *L. obovata* was in fourteen of these lesser streams, *L. o. sordida* in eleven.

To summarize: The heavy, most ornate and best characterized species are of the main river. In the main tributary, two of these riverine species persist to the Forks little modified, one is altered to sub-specific phase immediately after entering this tributary, one is altered just before the Forks are reached, two species appear

that are not in the main river. In that fork of the Obey River containing mollusca are still three of the riverine species, one of which retains the original characteristics save in the matter of size. Three species are present that were absent in lower waters. The pleurocerid fauna of the small tributaries is reduced to relatively small species of two genera. The relationship of all the species, one with another, is probably closer than may be presumed from the exo-skeletons alone. In any case, we have here a compact series of intimate adaptions to differing environments.

MOLLUSKS OF A KANSAS PLEISTOCENE DEPOSIT

BY CALVIN GOODRICH

In the summer of 1939, Mr. Claude M. Hibbard of the Museum of Paleontology, University of Kansas, carried on excavations in a deposit of Pleistocene times of Meade County, Kansas. The county is in the southwestern part of the state and borders on Oklahoma. It is about eighty miles east of the Colorado line. The drainage is through the Cimarron and Arkansas rivers to the Mississippi. The mollusean material, which I have examined, is in two zones, one of them fifteen feet below the top of the exposure, the other fifty feet below. Upon a chart with which Mr. Hibbard has kindly provided me the upper bed is described as "stream deposited sand with invertebrate and vert. fossils; fine sandy laminated clay, gray to bluish." The lower one is marked "Soil zone? Dark gray to dark slate color, sandy with few gastropods."

The shells of the upper zone are:

Gastrocopta armifera abbreviata (Sterki)
procera (Gould)
Hawaiia minuscula (Binney)
Pupoides inornatus Vanatta
marginatus (Say)
Pupilla muscorum (Linnaeus)
Vertigo modesta (Say)
ovata (Say)
Vallonia costata (Müller)
Succinea grosvernori Lea